

VARIATION IN SEEDLINGS OF CUPRESSUS
ABRAMSIANA WOLF

CALVIN McMILLAN

At the time of publication of the data concerning a third locality for *Cupressus Abramsiana* Wolf, comparative germination studies were being conducted on seeds collected in the three naturally occurring populations of this species (McMillan, Madroño 11:188-194. 1952). The rate of germination and the seedling characteristics had been ascertained for other members of the species-complex to which *C. Abramsiana* is closely related, and it seemed unlikely that any significant variations would be discernible in *C. Abramsiana*. In an earlier study, it was noted that seeds of *C. Abramsiana* from the Bonny Doon population (southernmost of the three populations in the Santa Cruz Mountains) showed a similarity to those of *C. Goveniana* Gord. in rate of germination and in seedling characteristics, while seeds from the Eagle Rock population (seven miles to the north) yielded few seedlings. Little significance was attached to this small yield at that time, however, as it was assumed to have been caused by faulty procedure. No duplications of the planting had been made.

In the present studies for the purpose of comparing germination behavior, one hundred seeds of each population of *C. Abramsiana* (this time including the northernmost population on Butano Ridge in San Mateo County, about eight miles north of Eagle Rock) were planted in each of two different soils as part of a soil-tolerance study. All seeds of *C. Abramsiana* used in the present studies were collected on September 1, 1951 as a random sampling from representative portions of each of the three populations, and they were planted on September 29, 1951.

The usual time required for germination in *Cupressus* is two weeks to one month. By October 15, 1951, no seeds of the Eagle Rock population had germinated, although 23 seedlings representing the Butano Ridge population and 13 of the Bonny Doon population had appeared. Those from Butano Ridge were first to germinate. On January 11, 1952, nearly three and one-half months following planting, a final count was made and the seedlings were compared as to cotyledon number (Table 1).

A striking differential of germination of seeds from the three populations of *C. Abramsiana* is shown in the present studies, although the rate of germination on two soils (a serpentine soil and a sandy soil) was approximately equal in the case of each population. Seeds from the Butano Ridge population had the highest germination rate (92.5 per cent); those from Eagle Rock had considerably the lowest (12.5 per cent); those from Bonny Doon were intermediate (56.5 per cent).

TABLE 1. DISTRIBUTION OF NUMBER OF COTYLEDONS

Species, Strain and Seed Lot Designation	Number of Seedlings				Total
	Two	Three	Four	Five	
<i>Cupressus Abramsiana</i> Butano Ridge (123), San Mateo County	0	15	125	45	185*
Eagle Rock (125), Santa Cruz County	0	0	19	6	25*
Bonny Doon (127), Santa Cruz County	0	56	56	1	113*
<i>Cupressus Sargentii</i> Mt. Tamalpais (39), Marin County	0	78	84	10	172
<i>Cupressus Goveniana</i> Huckleberry Hill (29), Monterey County	0	78	28	0	106
<i>Cupressus pygmaea</i> Mendocino City (1), Mendocino County	18	138	8	0	164
Anchor Bay (17), Mendocino County	7	108	14	0	129
Total	25	473	334	62	894

*Seedlings of *Cupressus Abramsiana* resulted from germination of two hundred seeds which were planted for each population. Seedlings of other species were the total available at time of study.

Thus these later tests upheld the difference in germination rate that had been noted in the preliminary study. The cause of this low germination in the Eagle Rock population is not known, but in this regard it is interesting to note that *C. Sargentii* Jeps. and *C. Goveniana*, which have been hypothesized as possibly having hybridized in the past to produce *C. Abramsiana*, differ in their rate of germination. Owing to a dormancy factor, *C. Sargentii* has a very low rate of germination, usually 2-5 per cent, and the germination rate of *C. Goveniana* is usually 50-60 per cent.

The variation in number of cotyledons among the three populations of *C. Abramsiana* is perhaps significant as an indication that juvenile characteristics sometimes can be utilized in *Cupressus* in addition to characteristics which distinguish the mature trees. The high incidence of seedlings with four and five cotyledons in both the Eagle Rock and Butano Ridge material might be used to substantiate the similarity of mature trees from these two populations. The rare occurrence of seed-

lings with five cotyledons and the occurrence in equal numbers of seedlings with three and four cotyledons in the Bonny Doon material conceivably might be cited as an additional character which distinguishes trees at Bonny Doon from those of the Eagle Rock and the Butano Ridge populations.

The inclusion, by some, of the populations of *C. Abramsiana* in *C. Sargentii* could be partially substantiated by the common occurrence of seedlings with five cotyledons. However, a postulated origin of *C. Abramsiana* by hybridization of *C. Sargentii* and *C. Goveniana* also finds confirmation in cotyledon number in addition to the variation in cone size, seed size, seed color and glaucousness and foliage color known to occur in the three taxa. In regard to cotyledon number it is of interest to note that two spatially isolated populations of *C. pygmaea* (Lemm.) Sarg., differing among other things in their habit of growth and seed color, are similar in range of cotyledon number (Table 1). *Cupressus pygmaea* yields frequent seedlings with two cotyledons, differing in this respect from *C. Goveniana*, a species to which it is very closely related.

The characteristic bluish gray-green color of the seedlings of *C. Sargentii* is due to a heavy glaucousness which can easily be wiped off the juvenile leaves. Although the seedlings of *C. Abramsiana* are grayish-green in color, the presence of glaucousness is less evident and more variable than in *C. Sargentii*. Of the three populations, the seedlings representing the Butano Ridge area are characteristically the most glaucous, being uniformly so, those from Bonny Doon are least glaucous, and those from Eagle Rock are extremely variable in respect to glaucousness, some being not glaucous. In contrast, seedlings of *C. Goveniana* are not glaucous, being distinctly bright green.

A conclusion which is reached from the foregoing data is that seedling characteristics and rate of germination do characterize the three populations of *C. Abramsiana* as a variable assemblage, which as now understood, could conceivably represent the results of hybridization. In no other Californian species of *Cupressus* does the known range of variability over such a limited area equal that found in the case of *C. Abramsiana*.

Department of Botany,
University of California, Berkeley.